

CLAIMS

What is claimed is:

1. A method of fracturing a subterranean formation of an oil or gas well to stimulate production of hydrocarbons, the method comprising the steps of:

5 (1) injecting at high pressure into the formation a fracturing fluid comprising an aqueous acid, a synthetic polymer, a metal crosslinking agent and lactic acid or a salt thereof;

(2) crosslinking the synthetic polymer and metal crosslinking agent at a temperature of at least 100° F for a time sufficient to render a crosslinked acid gel.

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2. The method of Claim 1, wherein the synthetic polymer and metal crosslinking agent are crosslinked at a temperature of at least 120° F.

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3. The method of Claim 2, wherein the synthetic polymer and metal crosslinking agent are crosslinked at a temperature of at least 140° F.

4. The method of Claim 1, wherein the lactic acid is present at a concentration of from about 10 to about 1,000 pounds of lactic acid per 1,000 gallons of fracturing fluid.

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5. The method of Claim 4, wherein the lactic acid is present at a concentration less than about 80 pounds of lactic acid per 1,000 gallons of fracturing fluid.

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6. The method of Claim 5, wherein the lactic acid is present at a concentration less than about 25 pounds of lactic acid per 1,000 gallons of fracturing fluid.

7. The method of Claim 1, wherein the aqueous acid is hydrochloric acid.

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8. The method of Claim 7, wherein the aqueous acid further includes formic acid, acetic acid or mixtures thereof.

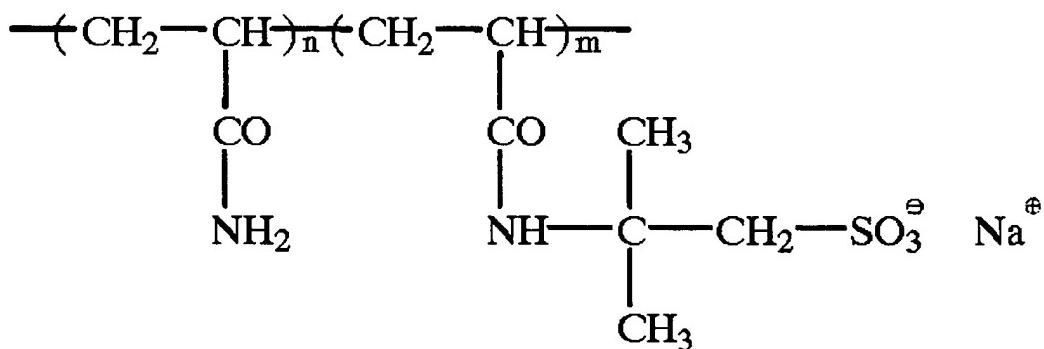
9. The method of Claim 1, wherein the metal crosslinking agent contains
5 either titanium, zirconium, aluminum, iron or antimony or a mixture thereof.

10. The method of Claim 9, wherein the metal crosslinking agent contains aluminum and zirconium.

10 11. The method of Claim 9, wherein the metal crosslinking agent is zirconium oxychloride, zirconium acetate, zirconium lactate, zirconium malate, zirconium citrate, titanium lactate, titanium malate, or titanium citrate or a combination thereof.

15 12. The method of Claim 1, wherein the synthetic polymer is polyvinyl alcohol, polyacrylamide or a copolymer of acrylamide.

13. The method of Claim 12, wherein the synthetic polymer is a copolymer of



20 wherein m is 2 to 5 and n is 4 to 8.

14. The method of Claim 1, wherein the fracturing fluid further comprises a gel breaker.

15. A fracturing fluid for enhancing the productivity of a hydrocarbon-bearing formation comprising

- (a) an aqueous acid;
- (b) a synthetic polymer;
- (c) lactic acid or a salt thereof; and
- (d) a metal crosslinker.

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16. The fluid of Claim 15, wherein the lactic acid is present at a concentration of from about 10 to about 1,000 pounds per 1,000 gallons of fracturing fluid.

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17. The fluid of Claim 16, wherein the lactic acid is present at a concentration less than about 80 pounds per 1,000 gallons of fracturing fluid.

18. The fluid of Claim 17, wherein the lactic acid is present at a concentration less than about 50 pounds per 1,000 gallons of fracturing fluid.

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19. The fluid of Claim 15, wherein the aqueous acid is hydrochloric acid.

20. The fluid of Claim 19, wherein the aqueous acid further includes formic acid, acetic acid or a mixture thereof.

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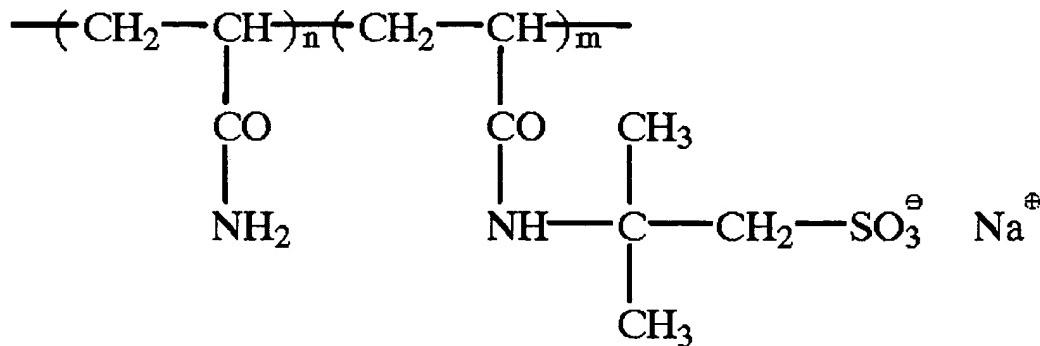
21. The fluid of Claim 15, wherein the metal crosslinking agent contains either titanium, zirconium, aluminum, iron or antimony or a mixture thereof.

22. The fluid of Claim 21, wherein the metal crosslinking agent contains aluminum and zirconium.

5 23. The fluid of Claim 21, wherein the metal crosslinking agent is zirconium oxychloride, zirconium acetate, zirconium lactate, zirconium malate, zirconium citrate, titanium lactate, titanium malate, or titanium citrate or a combination thereof.

10 24. The fluid of Claim 15, wherein the synthetic polymer is polyvinyl alcohol, polyacrylamide or a copolymer of acrylamide.

25. The fluid of Claim 24, wherein the synthetic polymer is a copolymer of



15 wherein m is 2 to 5 and n is 4 to 8.

26. The fluid of Claim 15, further comprising a gel breaker.

27. In a method of fracturing a subterranean formation of an oil or gas well to
20 stimulate production of hydrocarbons by injecting at high pressure into the formation a
fluid comprising an aqueous acid, a synthetic polymer, and a metal crosslinking agent,
the improvement comprising using, as a delaying agent, lactic acid or a salt thereof.

28. The method of Claim 27, wherein the lactic acid is present at a concentration of from about 10 to about 1,000 pounds of lactic acid per 1,000 gallons of fracturing fluid.

5 29. The method of Claim 28, wherein the lactic acid is present at a concentration less than about 80 pounds per 1,000 gallons of fracturing fluid.

30. The method of Claim 29, wherein the lactic acid is present at a concentration less than about 25 pounds per 1,000 gallons of fracturing fluid.

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31. The method of Claim 27, wherein the aqueous acid is hydrochloric acid.

32. The method of Claim 31, wherein the aqueous acid further includes formic acid, acetic acid or mixture thereof.

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33. The method of Claim 27, wherein the metal crosslinking agent contains either titanium, zirconium, aluminum, iron or antimony or a mixture thereof.

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34. The method of Claim 33, wherein the metal crosslinking agent contains

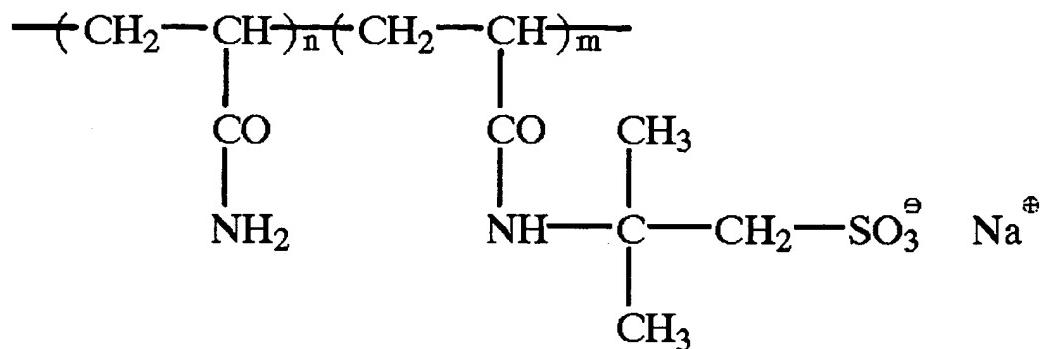
aluminum and zirconium.

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35. The method of Claim 33, wherein the metal crosslinking agent is zirconium oxychloride, zirconium acetate, zirconium lactate, zirconium malate, zirconium citrate, titanium lactate, titanium malate, or titanium citrate or a combination thereof.

36. The method of Claim 27, wherein the synthetic polymer is polyvinyl alcohol, polyacrylamide or a copolymer of acrylamide.

37. The method of Claim 36, wherein the synthetic polymer is a copolymer of



wherein m is 2 to 5 and n is 4 to 8.

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38. The method of Claim 27, wherein the fluid further comprises a gel breaker.